1974

Eighteenth Annual Cattle Feeders Day

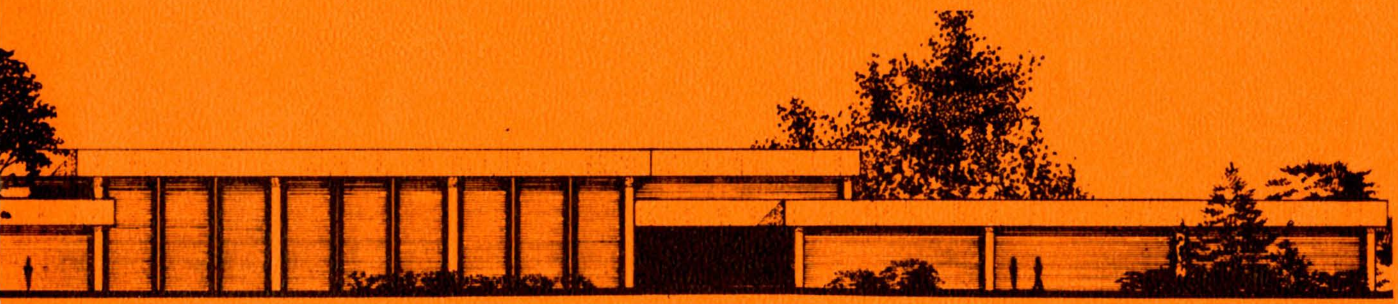
Animal Science Department
South Dakota State University

Eighteenth Annual

Cattle Feeders Day

Friday, November 1, 1974

Research Summaries



Department of Animal Science
Agricultural Experiment Station
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WEST ELEVATION

NORTH ELEVATION

EAST ELEVATION

South Dakota State University
Brookings, South Dakota

Department of Animal Science
Agricultural Experiment Station

A.S. Series 74-1

Pine Sawdust as a Roughage Substitute in Beef Finishing Rations

L. D. Kamstra and A. L. Slyter

Previous reports discussed toxicity trials with untreated sawdust, indicating no toxicity to ruminants when fed up to 25% of the ration. The low digestibility (7-10%) of softwood sawdust produced from the mills in western South Dakota limits its usage as a major ration component. The objective of this experiment is to demonstrate the usage of ponderosa pine (Pinus ponderosa) sawdust as a nonnutritive roughage component in beef finishing rations.

Materials and Methods

Thirty-six yearling Hereford heifers were randomly allotted to four treatment groups based on the type to be fed. The rations were (1) all concentrate, (2) 15% alfalfa (control), (3) 15% sawdust and (4) 5% alfalfa, 10% sawdust. Ration composition is shown in table 1. All rations were mixed weekly and self-fed in covered bunks on a concrete apron after the animals were brought to full feed. Animals were fed in open dirt lots without shelter in northwest South Dakota during October to February for a period of 126 days. Coarse ponderosa pine sawdust was obtained every 2 to 3 weeks directly from the mill at 30 to 50% moisture with no treatment other than removal of chips larger than one-half inch. Actual sawdust in the ration was adjusted to 80% dry matter to assure uniformity of ration preparation.

Animals were slaughtered at a commercial packing plant and carcass data collected following a 24-hour chill. Subjective carcass parameters were taken by the Federal Grader on duty at the plant. Steaks from the anterior rib region were used for taste panel evaluation for tenderness, flavor and juiciness.

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Table 1. Percentage Composition of Rations

Ingredients	Ration number 1	2	3	4
Corn, cracked, shelled	86	74	67	70
Soybean meal, 44% crude protein[a]	13	10	17	14
Alfalfa hay, coarse ground	--	15	--	5
Pine sawdust, raw untreated[b]	--	--	15	10
Dicalcium phosphate, 24% Ca, 18% P	1	1	1	1
Chemical analysis[c]				
Crude protein, moisture-free basis	18.16	17.95	17.08	17.54
Moisture, as fed basis	17.42	15.52	24.04	20.96
Cellulose, moisture-free basis	5.01	8.62	12.70	11.51
Calculated TDN, moisture-free basis[d]	87.7	82.9	74.2	77.1

[a]13,228 IU of vitamin A added per kilogram of SBOM.
[b]Adjusted to 80% dry matter basis.
[c]Average of four monthly samples.
[d]Values used to calculate TDN were as follows: corn, 89%; soybean meal, 86%; alfalfa hay, 56% and sawdust, 0%.

Results and Discussion

There were no significant differences in total gain and final shrunk weights between animals fed 15% alfalfa plus concentrate or when two-thirds of the alfalfa was replaced with an equal amount of sawdust (table 2). Although animal performance parameters were reduced from the 15% alfalfa ration when the roughage portion was solely from sawdust (15% of total ration), performance appeared more favorable than that of the all-concentrate ration. Hot carcass weights were significantly lower for those animals on the all-concentrate ration compared to the control ration (15% alfalfa).

Little or no differences were apparent between roughage and nonroughage rations with respect to feed required per unit of gain even though daily feed consumption was higher with roughage-containing rations (table 3).

No significant treatment differences were noted for dressing percent, carcass grade, marbling score, fat thickness, fat thickness per kg of carcass, rib eye area, rib eye area per kg of carcass, percent estimated kidney fat, estimated cutability or taste panel evaluation scores (table 2).

Roughage addition (alfalfa and/or sawdust) significantly reduced liver abscesses. Seventy-eight percent of the animals on the all-concentrate ration had abscessed livers as compared to 11% and 22% for those on alfalfa-containing rations and the ration containing only sawdust, respectively.

Table 2. Means of Performance and Carcass Measurements by Treatments

Item	Ration[a]				
	All concentrate	15% alfalfa	15% sawdust	5% alfalfa 10% sawdust	SE[b]
Initial wt., kg	268.6	268.8	270.2	268.2	5.44
Final shrunk wt., kg	343.8[f]	391.6	378.6[f]	391.3	7.89
Gain, kg	79.8[f]	130.7	107.0[f]	130.8	6.69
Avg. daily gain, kg	0.64[f]	1.04	0.85[f]	1.04	0.05
Hot carcass wt., kg	202.5	231.7	220.4	231.2	5.41
Dressing percent	58.9	59.2	58.3	59.2	0.49
U.S.D.A. carcass grade[c]	18.8	19.8	18.9	19.3	0.37
Marbling score[d]	4.8	6.0	5.2	5.1	0.30
Fat thickness, 12th rib, cm	0.93	1.09	0.97	1.10	0.10
Fat thickness/100 kg carcass, cm	0.45	0.47	0.44	0.47	0.04
Rib eye area, cm^2	64.2	72.8	68.4	68.5	2.44
Rib eye area/100 kg carcass, cm^2	31.6	31.5	31.0	29.6	1.04
Kidney fat, %	1.9	2.8	2.3	2.5	0.24
Cutability estimate, %	51.5	51.2	51.4	50.8	0.37
Condemned livers, %	77.8	11.1	22.2	11.1	
Taste panel evaluation[e]					
Tenderness	3.8	4.3	4.5	4.7	0.34
Flavor	3.5	3.4	3.5	3.7	0.19
Juiciness	3.1	3.3	3.2	3.3	0.19

[a] See table 1 for complete ration composition.
[b] Standard error of treatment means.
[c] Score of 13 = low standard, 14 = average standard, etc. through 24 = high prime.
[d] Score of 1 = devoid, 2 = practically devoid, etc. through 12 = extremely abundant.
[e] Score of 1 = extremely desirable, etc. through 8 = extremely undesirable.
[f] Means followed by a superscript differ significantly ($P<.05$) from the control ration (15% alfalfa).

To convert kilograms to pounds multiply by 2.2. To convert centimeters to inches multiply by 0.4.

Table 3. Mean Feed Consumption by Treatment

Item	Ration[a] All concentrate	15% alfalfa	15% sawdust	5% alfalfa 10% sawdust
Avg. daily ration, kg				
As fed basis	5.53	8.24	8.68	8.85
Dry basis	4.57	6.96	6.59	7.00
Feed/kg gain, kg				
As fed basis	8.64	7.92	10.21	8.51
Dry basis	7.13	6.69	7.76	6.73
TDN/kg gain, kg[b]	6.25	5.55	5.77	5.19

[a]See table 1 for complete ration composition.
[b]Calculated TDN, dry basis.

To convert centimeters to inches multiply by 0.4.

Summary and Conclusions

Feeding of untreated ponderosa pine sawdust at levels up to 15% of a high concentrate ration appears feasible without substantial loss in animal performance. It would be expected that the feeding of coarse sawdust would also serve in reducing liver abscesses commonly associated with high concentrate feeding. Sawdust at this level in a ration should not be toxic to ruminant animals or contribute any undesirable factors to the meat products.

The economic importance of utilizing sawdust in this manner will depend on the current market price of alfalfa or other roughage, transportation charges and availability of an adequate sawdust supply. Experiments are continuing on treatment methods of all fibrous wastes to increase their potential as animal feeds, especially in maintenance rations.

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A.S. Series 74-2

Quality Measurement of Hay Stored by Large Hay Packaging Systems

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Introduction

Large hay packaging systems are becoming increasingly popular as a means of storing hay conveniently with a minimum amount of labor. It has been noted that as much as 28% of the hay crop may be lost during the number of sequential operations involved in traditional hay making. The "one-man operation" packaging systems may allow harvesting at higher than normal moisture levels (approximately 30%) which reduces the chances of leaf loss and weathering during drying in a field. It follows, however, that quality loss during storage might be a greater problem with forage stacked at higher moisture levels. Such loss of quality may be difficult to determine by visual observation only, except for mold and/or color changes.

The purpose of this study was to determine to what extent large hay package storage retained the initial forage quality by measurement of seven quality parameters over an extended period. The Hesston 60 and Haybuster 1800 were used as examples of hay packing systems for study.

Materials and Methods

Seventy-three samples of alfalfa forage were taken in different locations from three Hesston stacks located on the Richards Farm near Ipswich during three collection periods (June 6, 1972; Oct. 10, 1972 and May 5, 1973). A similar sampling (207 samples) was made from three Hesston stacks at the Richards Farm and three Haybuster stacks at the Pasture Research Center at Norbeck on June 13, 1973; July 12, 1973 and October 19, 1973.

The quality measurements--moisture, crude protein (CP), ash, neutral-detergent fiber (NDF), acid-detergent fiber (ADF), acid-detergent lignin (ADL), Crampton and Maynard cellulose (CMC) and *in vitro* dry matter digestibility (IVDMD)--were made on all samples collected over this 2 year period. Using a multiple regression equation, quality components were compared as independent variables to *in vitro* dry matter digestibility as a dependent variable to determine which single or combination of quality components exerts the greatest influence on digestibility. Previous research has shown laboratory digestibility to be highly related to actual digestibility trials.

Results and Discussion

It was shown that nearly 40% of the variation in digestibility could be accounted for by the two quality components, acid-detergent lignin and neutral-detergent fiber (table 1). This would suggest that of the quality components measured these two appear

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to have the most influence on animal utilization of forage material. Neutral-detergent fiber can be an indirect measure of plant cell contents, whereas lignin is a measure of plant encrustation. It has long been known that as the lignin content of a plant increases digestibility decreases, since lignin encrustation inhibits digestibility by rumen microorganisms.

Using only three quality components, neutral-detergent fiber, acid-detergent fiber and *in vitro* digestibility in equation form, a single value or quality index was developed. The values for all samples taken from the stacks are represented in the index and compared to a hay "standard" of known quality. A regression equation was obtained using all values which contributed significantly to the regression.

A summary of hay quality parameter measurements of each stack is shown in table 2. The data were used in the Stepwise-Forward Multiple Regression method of selection of quality parameters for an index equation. This procedure involved the use of the dependent variable (IVDMD) and seven independent variables (ADF, NDF, ADL, CP, CMC, ash and moisture). The proportion of the variability contributed by each independent variable is explained in table 1. The regression equation obtained using all values which contribute significantly to the regression was Y = 86.4 - 0.75 (ADL,%) - 0.34 (NDF,%) + 1.37 (moisture,%) + 0.31 (crude protein,%) - 0.54 (ash,%).

A more simplified equation, Y = 87.8 - 1.33 (ADL) - 0.258 (NDF), is more practical and would be justified since ADL and NDF explained 39.3% of the total variability accounted for by all quality parameters measured (49.0%).

If the simpler equation was used, an example would be as follows:

1. Substitute values into equation of a known standard of choice to obtain a comparison for quality index--for example, immature alfalfa having values of 3.0 and 37.0% ADL and NDF, respectively

$$Y = 87.8 - 1.33\ (3.0) - 0.258\ (37.0)$$

$$Y = 87.8 - 13.54$$

$$Y = 74.26$$

$$\frac{74.26}{74.26} \times 100 = 100$$

2. Substituting mean values of ADL and NDF obtained from stack 1 on the first (a) and third (b) collection dates, we obtain

   a. Stack 1, collection 1

$$Y = 87.8 - 1.33\ (7.0) - 0.258\ (55.7)$$

$$Y = 87.8 - 23.7$$

$$Y = 64.1$$

b. Stack 1, collection 3

$$Y = 87.8 - 1.33\ (10.0) - 0.258\ (70.0)$$

$$Y = 87.8 - 31.36$$

$$Y = 56.44$$

3. Nutritive value index (NVI) values relative to the standard forage were then calculated

a. $NVI = \frac{64.1}{74.26} \times 100 = 86.3$

b. $NVI = \frac{56.44}{74.26} \times 100 = 76.0$

IVDMD values decreased approximately 22.5, 13.5, and 10.1 percentage units during a period of 1 year storage in stacks 1, 2, and 3, respectively. NVI values for collections 1, 2, and 3 in stacks 1, 2, and 3 decreased approximately 10.3, 13.0, and 10.5 nutritive value units, respectively.

The results of the NVI calculations above indicate a reduction of 10.3 nutritive value units in the first year of storage in stack 1. IVDMD during this same period indicated a reduction of 22.5 percentage units in the same stack.

Table 1. Stepwise-Forward Multiple Regression of Seven Chemical Components on *In Vitro* Dry Matter Digestibility

Independent variable[a]	Proportion explained	Total explained
	%	%
ADL[b]	30.1	30.1
NDF[b]	9.2	39.3
Moisture	6.4	45.7
Crude protein	1.4	47.1
Ash	1.6	48.7
CMC[b]	0.3	49.0
ADF[b]	0.0	49.0
Total for all seven variables		49.0

[a]Each independent variable was regressed on IVDMD.
[b]ADL = acid-detergent lignin, NDF = neutral-detergent fiber, CMC = Crampton and Maynard cellulose and ADF = acid-detergent fiber.

Table 2. Average Composition of Nine Stacks and Three Collection Dates

Stk.	Date	ADF[a]	NDF	ADL	CMC	CP	IVDMD	Moisture	Ash
1	6-15-72	40.27	55.65	7.04	33.43	12.87	72.66	35.80	11.90
1	10-10-72	44.22	62.08	8.28	33.91	13.31	63.94	11.70	12.28
1	5- 2-73	46.11	70.38	10.02	45.06	13.09	50.13	7.90	9.94
2	6-15-72	36.98	49.93	6.86	31.14	22.10	67.69	31.80	13.38
2	10-10-72	43.91	59.90	7.88	34.08	21.35	68.47	11.40	13.11
2	5- 2-73	44.57	70.13	10.30	39.15	13.37	54.23	7.60	9.58
3	6-15-72	39.93	56.22	6.42	34.13	12.16	65.67	29.00	12.37
3	10-10-72	43.23	62.08	7.76	36.11	12.77	57.56	11.33	12.41
3	5- 2-73	44.50	70.55	9.51	43.60	12.48	55.56	8.02	9.61
4	6-13-73	27.96	49.94	8.29	23.31	17.97	66.28	34.20	11.15
4	7-12-73	33.76	50.88	10.65	23.37	18.52	61.47	18.83	11.61
4	10-19-73	31.29	53.94	8.07	23.70	18.22	63.99	9.90	11.91
5	6-13-73	29.16	53.03	7.22	23.73	17.92	64.24	29.50	10.89
5	7-12-73	33.86	52.19	12.29	24.09	18.76	61.30	16.00	11.10
5	10-19-72	31.30	53.75	7.55	23.64	17.85	63.19	9.80	11.36
6	6-13-73	30.53	55.24	7.79	25.34	17.76	64.14	32.30	10.81
6	7-12-73	35.32	53.95	9.90	25.67	18.01	61.00	12.17	11.46
6	10-19-73	33.00	52.03	8.09	26.52	17.66	62.88	9.10	11.25
7	6-13-73	32.48	52.81	7.77	27.18	17.42	62.41	39.90	12.05
7	7-12-73	37.42	54.39	9.17	26.25	16.68	58.12	12.83	13.88
7	10-19-73	36.44	52.59	7.89	27.92	16.47	57.97	9.70	13.10
8	6-13-73	32.32	53.28	7.95	28.38	16.19	62.82	40.10	11.98
8	7-12-73	37.35	55.11	9.05	26.57	16.58	56.87	13.42	16.82
8	10-19-73	36.38	55.54	8.00	28.44	16.64	59.59	9.67	12.44
9	6-13-73	33.52	54.72	7.64	28.11	17.13	63.40	39.80	11.29
9	7-12-73	36.52	56.69	8.74	26.36	17.08	57.77	11.30	15.43
9	10-19-73	34.89	55.21	7.40	27.49	16.95	61.60	8.90	11.67

[a]ADF = acid-detergent fiber, NDF = neutral-detergent fiber, CMC = Crampton and Maynard cellulose, ADL = acid-detergent lignin, CP = crude protein and IVDMD = *in vitro* dry matter gestibility.

Summary and Conclusions

A Nutritive Value Index System has been proposed for alfalfa hay stored by large hay packaging systems which uses three quality component measurements. It was formulated by determination of the contribution of various quality components to the variability of *in vitro* digestibility of forage stored by the Hesston and Haybuster packaging systems. The index system is only in its formative stages and will require usage with forage stored for longer periods than 1 year and with other forage species. Mixed prairie hay stacks are presently being sampled for analysis.

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A.S. Series 74-3

Diethylstilbestrol, Zeranol or Synovex-S Implants for Growing Steers

L. B. Embry and W. S. Swan

Numerous experiments during the past several years have shown that implanting feedlot steers or heifers with diethylstilbestrol (DES), zeranol or Synovex results in an increase in rate of gain with improved feed efficiency. Comparisons between the three products under various conditions are more limited. Therefore, comparative effects of DES, zeranol and Synovex-S were tested in a growing experiment where steers were full-fed corn silage with 2 lb. per head daily of protein supplement for a period of about 3 months.

Procedures

The experiment involved 24 pens of steers with 6 (3 Hereford x Angus and 3 Hereford) per pen. Average shrunk weight at the beginning of the experiment was about 525 pounds.

Four implant treatments used were a nonimplanted control, 36 mg DES, 36 mg zeranol and Synovex-S (200 mg progesterone and 20 mg estradiol benzoate). Each implant treatment was administered to 6 pens of steers at the beginning of the experiment.

Diets were composed of a full feed of corn silage and 2 lb. of a protein supplement. The protein supplements were formulated to contain 32% protein using either soybean meal or urea as the supplemental source. The supplements were fortified with adequate levels of vitamin A and minerals. Chlortetracycline-sulfamethazine was included in the supplements during the first month of the experiment and then chlortetracycline for the remainder of the experiment.

The experiment was terminated after 93 days. A final shrunk weight was obtained following an overnight stand without feed and water. Feeding during the experiment was once daily in outside pens without shade or shelter.

Results

Results of the experiment are presented in table 1. Nonimplanted control steers gained 2.10 lb. daily. All implant treatments resulted in improved weight gains. The improvement amounted to 11.0, 13.3 and 13.8%, respectively, for 36 mg zeranol, Synovex-S and 36 mg DES.

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Feed consumption was slightly higher for implanted steers with an improvement in feed efficiency. The improvement over nonimplanted controls amounted to 8.2, 9.5 and 9.8%, respectively, for zeranol, Synovex-S and DES.

Rates of gain were high for a diet of corn silage and 2 lb. of protein supplement. The corn silage was of excellent quality from well-eared corn. The results were likely influenced to some extent by the initial condition of the steers and by a relatively short feeding period. However, improvements in weight gain and feed efficiency represent typical ones reported previously by several researchers for these products.

Summary

One hundred forty-four steers were used in a growing experiment and full-fed corn silage with 2 lb. daily of a 32% protein supplement. Nonimplanted control steers gained 2.10 lb. daily during the 93-day experiment. Those implanted with 36 mg zeranol, Synovex-S or 36 mg DES gained 11.0, 13.3 and 13.8%, respectively, more than the controls. Implant treatments resulted in slightly higher feed consumption but with an improvement in feed efficiency. The improvement over controls amounted to 8.2, 9.5 and 9.8%, respectively, for zeranol, Synovex-S and DES.

Synovex-S and DES resulted in similar weight gains and feed efficiency. The response from zeranol was only slightly less. Each of the three products offer a means for substantial improvements in weight gain and feed efficiency with growing-type diets as used in this experiment.

Table 1. Implant Treatments for Growing Cattle
(Feb. 6 to May 10--93 days)

	Control	Zeranol	Synovex	DES
No. of animals	36	36	35	36
Init. shrunk wt., lb.	525	525	526	525
Final shrunk wt., lb.	720	742	747	747
Avg. daily gain, lb.	2.10	2.33	2.38	2.39
Avg. daily feed, lb.	34.17	34.97	35.17	35.11
Feed/100 lb. gain, lb.	1638	1503	1482	1477

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A.S. Series 74-4

Soybean Meal and Urea Supplements with Corn Silage at Various Stages of Feeding for Growing Cattle

L. B. Embry and W. S. Swan

Calves weaned and fed supplements containing urea generally have a period of reduced performance in comparison to those fed soybean meal supplements. The period of reduced gains may last for 3 to 4 weeks for calves unadapted to urea, but it may vary in length and severity depending upon the level of urea, energy concentration of the diet, age of cattle and stresses to which subjected prior to arrival and at the feedlot. The period of reduced performance appears to become of lesser importance with increasing age of the cattle.

There is some evidence that the effects from adaptation to urea may be partially offset by gradual increases in urea over a period of about 1 month starting at relatively low levels. Feeding soybean meal to calves as the major supplemental protein for about 1 month before introducing urea has been reported to be beneficial in overcoming the period of reduced performance from adaptation to urea.

Under investigation in this experiment were the comparative values of soybean meal, urea and a combination of the two during the first month of feedlot adaptation of calves. Also tested were the effects of changes in the source of supplemental protein after 1 month in the feedlot.

Procedures

The steers used in the experiment were purchased about mid-January. They were fed about 5 lb. of alfalfa-bromegrass hay and a full feed of corn silage for about 3 weeks prior to starting the experiment.

One hundred forty-four steer calves (72 Hereford x Angus and 72 Hereford) were allotted into 24 pens of 6 each (3 of each breed group) for six supplement treatments. One of the four pens within each supplement group was implanted with 36 mg diethylstilbestrol, 36 mg zeranol, Synovex-S or served as the implant control. Allotment was at random to the 24 pens within weight groups of 24 after stratifying on basis of weight.

The dietary treatment during the first month of feedlot adaptation was a full feed of corn silage supplemented with soybean meal, urea or a combination of soybean meal and urea. Eight pens of calves were fed 2 lb. per head daily of the soybean meal supplement, eight pens fed the same level of the urea supplement and the other eight pens of calves were fed 1 lb. per head daily of each supplement.

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The supplements were formulated to contain 32% protein. They were fortified with minerals, vitamin A and chlortetracycline-sulfamethazine. Ingredient composition is shown in table 1.

Table 1. Ingredient Composition of Protein Supplements (Feedlot Adaptation Phase)

Ingredient	SBOM suppl.	Urea suppl.
	%	%
Ground corn grain	22.54	78.81
Soybean meal (44%)	67.65	
Urea (46% N)		9.30
TM salt	4.00	4.00
Limestone	2.20	
Dicalcium phosphate	3.00	4.50
Calcium sulfate (1 pt. S to 10 pt. N from urea)		2.58
TM premix		0.20
Vitamin A (30,000 IU/g) (15,000 IU/lb. suppl.)	0.11	0.11
Aureo S-700 (175 mg each of CTC and SMZ/lb. suppl.)	0.50	0.50

Following the first month of feedlot adaptation, four pens of calves from each supplement treatment group were fed soybean meal and the other four were fed the urea supplement for an additional period of 63 days (93 days for the entire experiment). The calves were not reallotted for this phase of the experiment. Initial designation of implant treatments was such that implant treatments were balanced within supplement groups.

Diets during this phase of the experiment were corn silage full-fed with 2 lb. of protein supplement. The protein supplements were as for the initial phase except vitamin A was reduced to 10,000 IU per lb. of supplement and chlortetracycline at 35 mg per lb. of supplement replaced the chlortetracycline-sulfamethazine mixture. Feeding was once daily in outside paved pens without access to shade or shelter.

Results

Results of the experiment after 30 days on basis of weights taken in early morning before feeding are shown in table 2. Steers fed corn silage supplemented with soybean meal gained at the fastest rate and 0.37 lb. more daily than those fed the urea supplement. Feeding the combination of soybean meal and urea offered no improvement over urea alone during this time of the experiment. Feed consumed was similar for each supplement group of cattle during the initial 30 days. Those making the faster rate of gain had lower feed requirements.

Table 2. Soybean Meal and Urea Supplements with Corn Silage at Various Stages in the Feeding Period (Day 1 to 30)

	Type of protein supplement		
	SBOM	Urea	SBOM-urea
No. of animals	47[a]	48	48
Initial filled wt., lb.	546.0	546.4	544.4
Filled wt., lb. (30 days)	617.4	606.8	602.4
Avg. daily gain, lb.	2.39	2.02	1.94
Avg. daily feed, lb.	25.99	25.76	25.85
Feed/100 lb. gain, lb.	1106	1286	1349

[a]One steer died. Results are presented for those finishing the experiment.

Results for the second month of the experiment following the changes in supplements are presented in table 3. There were only small differences in rate of gain between steers fed soybean meal for both months, those changed from urea to soybean meal, changed from the combination to soybean meal or changed from the combination to urea. In all cases, rates of gain were improved over the first month.

Table 3. Soybean Meal and Urea Supplements with Corn Silage at Various Stages in the Feeding Period (Day 31 to 58)

	Type of protein supplement					
Day 1 to 30	SBOM	SBOM	Urea	Urea	SBOM-urea	SBOM-urea
Day 31 to 58	SBOM	Urea	SBOM	Urea	SBOM	Urea
No. of animals	24	23[a]	24	24	24	24
Filled wt., lb. (30 days)	621.3	613.6	611.7	601.9	599.8	609.1
Filled wt., lb. (58 days)	695.2	680.4	682.9	661.5	672.6	678.7
Avg. daily gain, lb.	2.64	2.31	2.55	2.13	2.60	2.63
Accumulative daily gain, to date, lb.	2.54	2.30	2.29	2.05	2.25	2.28
Avg. daily feed, lb.	35.55	34.58	33.33	34.78	33.47	34.83
Feed/100 lb. gain, lb.	1346	1456	1319	1635	1293	1413

[a]One steer died. Results are presented for those finishing the experiment.

Steers fed urea for the first time gained at a lower rate (0.33 lb. daily) than those continued on soybean meal. The reduction in this case was of about the same amount as between soybean meal and urea during the first month.

Steers continued on urea gained only slightly more the second month than during the first one. Their rate of gain was considerably less (0.42 lb. daily) than for steers changed from urea to soybean meal after 1 month of the experiment. They also gained at a slightly lower rate than steers fed soybean meal and switched to urea after 1 month.

Average daily gains after 2 months were about the same for steers fed various combinations of soybean meal and urea. Those fed soybean meal both months gained about one-fourth pound more daily and those fed urea both months gained about this much less. Type of supplement appeared to have only a small effect on feed consumption as was true during the first month.

The supply of corn silage was fed up after 93 days. The cattle were weighed following an overnight stand without feed and water and the experiment terminated. Results for the 93 days on basis of shrunk weights are presented in table 4.

Table 4. Soybean Meal and Urea Supplements with Corn Silage at Various Stages in the Feeding Period (Feb. 6 to May 10--93 days)

	Type of protein supplement					
Adaptation phase	SBOM		Urea		SBOM and urea	
Growing phase	SBOM	Urea	SBOM	Urea	SBOM	Urea
No. of animals	24	23[a]	24	24	24	24
Initial shrunk wt., lb.	525.3	527.0	526.3	523.7	524.5	526.3
Final shrunk wt., lb.	757.3	736.6	740.2	723.5	736.2	740.8
Avg. daily gain, lb.	2.50	2.25	2.30	2.15	2.28	2.31
Avg. daily feed, lb.	35.33	35.17	34.00	35.07	34.13	35.43
Feed/100 lb. gain, lb.	1419	1572	1484	1635	1501	1541

[a]One steer died. Results are presented for those finishing the experiment.

Average daily gain after 93 days differed only slightly from the accumulative gains after 2 months except for some improvement for steers fed urea during the entire experiment. The advantage for soybean meal supplement appeared to result largely from the better performance of this group during the first month in the feedlot. The depressing effect of urea was similar whether fed upon arrival or after 1 month when the calves were on full feed. When urea was fed as the major supplemental protein, rate of gain was not equal to that of calves receiving other treatments until after about 2 months.

Supplement treatments appeared to have only small effects on feed consumption. Calves making the faster rates of gain had lower feed requirements.

Summary and Comments

Calves used in this experiment had been weaned and fed growing-type diets for about 3 months prior to purchase. They were fed corn silage and alfalfa-bromegrass hay without additional supplemental protein for 2 to 3 weeks prior to the experiment.

Those full-fed corn silage and soybean meal gained at the fastest rate (2.39 lb. daily) during the first month of the experiment. Feeding urea as the major supplemental protein resulted in lower (0.37 lb. daily) rates of gain. A combination of soybean meal and urea resulted in no improvement over urea alone during this time.

Changing the supplement from soybean meal to urea after 1 month resulted in a reduction in rate of gain in comparison to soybean meal of about the same amount (0.33 lb. daily) as during the first month of the experiment. Calves changed from the urea supplement to soybean meal or from the combination of soybean meal and urea to either soybean meal or urea gained at about the same rate during the second month of the experiment as those fed soybean meal from the beginning.

Calves fed urea from the beginning of the experiment continued to gain at a lower rate during the second month of the experiment. Thereafter, there was some compensatory gain for this group, resulting in a narrowing of the differences in weight gain in comparison to other groups at the end of the 93-day experiment.

Results of the experiment show that calves unadapted to urea may gain at a lower rate when fed urea in comparison to soybean meal with a full feed of corn silage. It appeared to make little difference whether the urea was offered at the beginning of the feeding period or 1 month later when on full feed. Any decision to delay feeding of urea for about 1 month should depend upon condition and health of the calves since a later date might be at a more favorable time as to general thrift and health of the animals.

A combination of soybean meal and urea appeared to offer no benefit over urea alone during the first month of feeding. After this first month, those fed urea gained as well as those fed soybean meal.

In general, there appeared to be little or no compensation for the reduction in performance upon introduction of urea to the diets except for those fed urea for the entire experiment and having a lower rate of gain during the first 2 months. In this case, the value of urea in comparison to soybean meal would likely depend to a large degree on the length of the feeding period. Any reduction in rate of gain for a period of a few weeks would be less important with increasing length of the feeding period.

Supplement treatments appeared to have little effect on feed consumption in this experiment. Therefore, calves making the faster rates of gain had lower feed requirements.

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A.S. Series 74-5

Effects of Monensin on Feedlot Performance of Growing and Finishing Steers[a]

L. B. Embry and W. S. Swan

Feed additives have become an important part of rations for feedlot cattle during the past several years. They have been shown to bring about improved performance in various ways such as stimulating growth, favorable alterations in fermentative and synthetic activity of the digestive tract and improvement in general health of the animals allowing more efficient absorption and utilization of nutrients consumed.

Much research has been devoted to the search for and study of compounds or products that may have important economic value as feed additives. Recent research has shown that monensin is such a compound. Monensin is a biologically active compound produced by streptomyces cinnamonensis and is used as an anticoccidial for poultry. It has been shown to favorably alter rumen fermentation resulting in an increase in propionic acid production which should be expected to improve feed efficiency.

In the experiment reported, monensin was tested at various levels as to effects on feedlot performance of steers during a growing phase with high-roughage rations and during a finishing phase with high-concentrate rations.

Procedures

The 128 Hereford steers used in the experiment were purchased in mid-May. They had been wintered as one group using a ration of alfalfa hay, corn silage and about 5 lb. of oats. Average weight at time of purchase was 608 pounds. They had been treated for control of internal and external parasites and had been given the vaccinations commonly associated with preconditioning and no additional treatments were given after arrival.

During a preliminary period of about 6 weeks, the steers were fed once daily a ration of 5 lb. whole corn grain and a full feed of alfalfa-bromegrass haylage (about 45% moisture).

High-Roughage Phase

Following the preliminary period, the cattle were allotted on basis of weight into 16 pens of 8 head each. Ration treatments were monensin at 0, 10, 20 or 30 g

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[a]Monensin used in the experiment supplied by Eli Lilly and Company, Greenfield, Indiana, through the courtesy of Dr. H. P. Grueter.

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per ton of air-dry ration. Each level of monensin was administered to four pens of cattle, two of which were fed alfalfa-bromegrass hay and two alfalfa-bromegrass haylage.

Rations during the high-roughage phase contained 75% alfalfa-bromegrass forage (hay or haylage) and 25% concentrates (corn and supplements) on an air-dry basis (90% dry matter). No supplemental protein was considered necessary with the high level of forage. However, a supplement was prepared to provide supplemental minerals, vitamin A and the test levels of monensin. These were mixed with ground corn and was supplemented at 5% of the air-dry ration. The control supplement contained 84% ground corn, 10% dicalcium phosphate and 6% trace mineral salt. Vitamin A was added to furnish 1,000 IU per pound of ration. A monensin premix was used to provide the test levels of the compound and replaced an equal weight of corn in the supplement. The final air-dry ration was 75% alfalfa-bromegrass forage, 20% ground corn and 5% supplement.

The ratio of 75% roughage to 25% concentrates on an air-dry basis was computed to the equivalent ratio as fed from moisture contents of feed determined periodically during the experiment. The concentrate mixture (corn and supplement) was also computed to an as-fed basis from moisture contents of the feeds. It was batch mixed daily with the roughage but not mixed together prior to feeding.

The cattle were fed in outside, paved pens without shade or shelter. This phase of the experiment was terminated after 111 days.

High-Concentrate Finishing Phase

Following termination of the high-roughage phase of the experiment, the steers were changed to high-concentrate rations. There were no changes in location or pen allotment. Final weights for the previous phase were used as the initial weights for this phase of the experiment. Experimental treatments for each pen of cattle were the same as during the high-roughage phase except for changes in the ratio of concentrates to roughage.

Rations contained 90% concentrates and 10% roughage (alfalfa-bromegrass hay or haylage) on an air-dry basis (90% dry matter). The cattle were changed from the previous high-roughage rations to the high-concentrate ones over a period of about 10 days.

A supplement to provide 10% of the air-dry ration was mixed with the corn in the same manner as for the previous phase. Ingredient composition of the control supplement was 83% ground corn, 4% urea (45% N), 5% dicalcium phosphate, 5% limestone and 3% trace mineral salt. Vitamin A was added to provide 1,500 IU per pound of air-dry ration. A monensin premix was used to provide the test levels (0, 10, 20 or 30 g/ton of air-dry ration) of the compound and replaced an equal weight of corn.

Appropriate levels of feeds as fed were computed from moisture contents of feed as during the previous phase of the experiment. Concentrates and roughage were fed separately once daily in amounts to be nearly consumed by the next feeding.

The experiment was terminated after 106 days of the finishing phase and the cattle marketed. Carcass data were obtained upon slaughter.

Results

High-Roughage Growing Phase

Results of the 111-day high-roughage phase of the experiment are presented in table 1. Rates of gain were high for the type of diet fed but with only small differences between treatment groups (2.48 to 2.53 lb. daily). Therefore, monensin appeared to have no effect on weight gains of the cattle.

Table 1. Monensin for Growing and Finishing Cattle for High-Roughage Phase (June 21 to Oct. 10--111 days)

	Monensin, g/ton air-dry feed			
	0	10	20	30
No. of animals	32	32	32	32
Init. shrunk wt., lb.	636.4	634.8	634.8	635.0
Final shrunk wt., lb.	911.4	911.1	915.9	909.7
Avg. daily gain, lb.	2.48	2.49	2.53	2.48
Avg. daily feed (air-dry), lb.				
Hay or haylage	19.93	19.26	18.81	17.83
Suppl.	1.32	1.28	1.25	1.19
Corn	5.36	5.17	5.05	4.79
Total	26.61	25.71	25.11	23.81
Feed/100 lb. gain (air-dry), lb.				
Hay or haylage	808	774	743	723
Suppl.	53	52	49	49
Corn	217	208	199	194
Total	1078	1034	991	966

Feed consumption decreased with increasing levels of monensin in the rations. The decrease in feed consumption but with similar rates of gain resulted in an improvement in feed efficiency with increasing levels of the compound. The improvement amounted to 4.1, 8.1 and 10.4%, respectively, for the 10, 20 and 30 g per ton levels.

There were no evident differences in eating patterns of cattle in the various treatment groups. The reduction in feed intake but with similar rates of gain and a resulting improvement in feed efficiency were consistent throughout the high-roughage phase of the experiment.

High-Concentrate Finishing Phase

Results of the high-concentrate finishing phase of the experiment are presented in table 2. Rates of gain were about the same between treatment groups except slightly lower for the highest level of monensin. Feed intake was reduced with increasing levels of the compound as occurred with the high-roughage rations. Feed efficiency was improved but slightly less than in the high-roughage phase. In this phase of the experiment, the improvement in feed efficiency for 10, 20 and 30 g per ton of monensin amounted to 1.7, 7.4 and 6.8%, respectively.

There were only small differences between treatment groups in the carcass characteristics measured except for a slight lower dressing percent and fat depth for cattle fed the highest level of monensin and making the lowest rate of gain. Abscessed livers were not reduced by the compound.

Table 2. Monensin for Growing and Finishing Cattle
High-Concentrate Finishing Phase
(Oct. 10, 1973 to Jan. 24, 1974--106 days)

	Monensin, g/ton air-dry feed			
	0	10	20	30
No. of animals	31	32	31	32
Avg. init. shrunk wt., lb.	909.9	911.1	914.9	909.7
Avg. final shrunk wt., lb.	1193.6	1190.4	1195.3	1180.0
Avg. daily gain, lb.	2.68	2.64	2.65	2.55
Avg. daily ration (air-dry), lb.				
Hay or haylage	3.15	3.07	2.93	2.87
Suppl.	1.29	1.22	1.09	1.04
Corn	17.84	17.24	16.26	15.81
Total	22.28	21.53	20.28	19.72
Feed/100 lb. gain (air-dry), lb.				
Hay or haylage	118	117	111	113
Suppl.	48	46	42	41
Corn	668	657	619	623
Total	834	820	772	777
Carcass data				
Number	30	30	31	30
Carcass wt., lb.	710.2	712.1	707.4	694.1
Dressing percent	59.35	59.91	59.21	58.87
Conformation[a]	21.2	21.4	20.9	21.0
Marbling[b]	5.3	5.4	5.4	5.2
Carcass grade[a]	19.0	19.1	19.3	18.9
Maturity[c]	23.0	23.0	23.1	23.0
Color[d]	4.7	4.6	4.8	4.6
Firmness[e]	5.4	5.1	5.3	5.2
% kidney fat	3.3	3.6	3.6	3.5
Loin eye area, sq. in.[f]	11.57 (30)	11.62 (29)	11.61 (28)	11.71 (24)
Fat depth, in.[f]	0.72	0.78	0.73	0.61
Condemned livers	6	11	7	13

[a]Prime = 23, choice = 20, good = 17.
[b]Modest amount = 6, small amount = 5.
[c]A maturity = 23, B maturity = 22.
[d]Light cherry red = 5, cherry red = 4.
[e]Firm = 6, moderately firm = 5.
[f]Some losses in carcass identification occurred in coolers. Values in parenthesis are number of carcasses for these characteristics.

Summary

Results of the experiment indicate that monensin reduces feed intake with either high-roughage or high-concentrate rations with little, if any, effect on rate of gain when fed at levels up to 30 g per ton of air-dry ration. These effects resulted in improved feed efficiency of 4.1, 8.1 and 10.4% with high-roughage rations and 1.7, 7.4 and 6.8% with high-concentrate rations for 10, 20 and 30 g of monensin per ton of air-dry ration. The effects appeared to be rather consistent throughout the two phases of the experiment. Levels of the compound used in the experiment appeared to have no important effects on carcass characteristics.

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A.S. Series 74-6

Protein Supplementation for Finishing Cattle Fed All-Concentrate or Low Roughage (Alfalfa) Diets

(Preliminary Report on Experiment In Progress)

L. B. Embry and W. S. Swan

Age, body weight, sex, weight gain and composition of the weight gain are animal factors involved in the total protein requirement for growing and finishing feedlot cattle. Protein requirements can be expected to vary as the animal grows and fattens and with the rate of growth and fattening. Therefore, protein requirements cannot be determined accurately for animals of various weights and rates of production in growing and finishing experiments. However, feeding trials are commonly used to determine animal response to various amounts or percentages of protein in supplements or the total diet. While not a precise measure of requirements at specific weights and rates of production, the method is of practical value in determining appropriate levels of supplementation under various conditions as to animals and diets.

The experiment reported here was conducted to determine the need for supplemental protein in all-concentrate diets composed largely of corn grain and in diets with low levels of roughage (4 lb. of alfalfa haylage). Cattle fed supplements with soybean meal or urea were compared to those fed similar diets without supplemental protein to the corn or corn and alfalfa haylage.

Procedures

The 144 steers (72 Hereford x Angus and 72 Hereford) used in the experiment were from a previous one where they were fed corn silage and protein supplement with soybean meal or urea as the major supplemental protein. They were adjusted to a high-concentrate diet of reconstituted high-moisture corn grain with 4 lb. of alfalfa haylage over a period of about 10 days. The corn was gradually increased to a full feed from an initial level of 5 lb. daily. Haylage was gradually decreased to the 4 lb. level from an initial daily rate of 18 pounds. No supplements were fed with the corn and haylage during a preliminary period of 42 days prior to the finishing experiment.

Dietary treatments for the finishing experiment consisted of a corn supplement, a soybean meal supplement and a urea supplement each fed at 2 lb. per head daily with the all-concentrate diet and the diet with 4 lb. of alfalfa haylage. Four pens of six cattle each (3 Hereford x Angus and 3 Hereford) were fed one of the six diets (24 pens).

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The cattle had previously received one of four implant treatments--36 mg zeranol, 36 mg diethylstilbestrol (DES), Synovex-S or served as nonimplanted controls. They were reimplanted with the same product and dosage level 105 days following the initial implanting (about 1 month before the finishing experiment). The cattle were reallotted within the four implant groups into 6 pens of 6 cattle, one of which received each of the six dietary treatments.

Corn grain was purchased about 1 month before the experiment and stored in a 17 ft. x 50 ft. oxygen-limiting silo. It was blown into the silo using a silo blower with water added to an auger ahead of the blower. Considerable cracking of the grain occurred and no further processing was used. Other animals were fed from the silo and it was refilled in the same manner in early August. Samples of corn are being collected at time of feeding for chemical analysis. Average protein content on a moisture-free basis is approximately 10.4%.

The haylage was first cutting alfalfa harvested in early June. It was stored in an upright concrete stave silo. Average moisture content as stored averaged about 42% and the protein content on a moisture-free basis was approximately 21%.

A corn-based supplement was used to provide diets with no supplemental protein to corn or corn and haylage. Soybean meal or urea was used in the other two supplements to give a protein content of about 32%. Ingredient composition of the supplements is shown in table 1.

Table 1. Ingredient Composition of Supplements

Ingredient	Corn suppl.	SBOM suppl.	Urea suppl.
	%	%	%
Ground corn grain, fine	81.08	16.58	71.18
Soybean meal (44%)	--	69.00	--
Urea (46% N)	--	--	8.7
Trace mineral salt, regular	3.00	3.00	3.00
Trace mineral premix	0.20	--	0.20
Dical + Monocal (Cyphos)	2.50	2.00	2.60
Limestone	7.00	6.00	5.60
Calcium sulfate	--	--	2.40
Potassium chloride	5.80	3.00	5.90
Vitamin A (30,000 IU/g) (10,000 IU/lb.)	0.70	0.70	0.70
Vitamin E (100,000 IU/lb.) (200 IU/lb. suppl.)	0.9 gm	0.9 gm	0.9 gm
Aureomycin-10 (35 mg CTC/lb. suppl.)	0.35	0.35	0.35
Percent composition (Calculated)			
Protein	8.11	32.02	32.09
Ca	3.18	2.93	3.18
P	0.70	0.67	0.69
K	3.13	3.07	3.16

The cattle were fed once daily in outside, paved pens without shade or shelter.

Results

The experiment is in progress and preliminary results after 98 days are shown in table 2. Rate of gain up to this time is slightly greater for soybean meal and slightly less for urea in comparison to the group without supplemental protein with the all-concentrate diet and the diet with 4 lb. of alfalfa haylage. Feed consumption has been about the same for steers fed the corn supplement or soybean meal. Urea appears to have reduced feed intake either with or without haylage. Steers fed supplemental protein have lower feed requirements than those fed the corn supplement.

Table 2. Level and Source of Protein for Finishing Cattle Fed Diets With and Without Roughage

	Corn		SBOM		Urea	
Alfalfa haylage	0	4 lb.	0	4 lb.	0	4 lb.
No. of animals	24	24	23	24	24	24
Init. filled wt., lb.	779	777	776	775	777	779
Final filled wt., lb.	1041	1086	1050	1100	1031	1081
Avg. daily gain, lb.	2.68	3.15	2.80	3.32	2.59	3.08
Avg. daily feed, lb.						
HM corn grain	19.34	20.37	19.24	20.35	18.08	18.99
Haylage	0.14	3.96	0.14	3.96	0.14	3.96
Suppl.	2.00	1.98	1.98	1.98	1.98	1.98
Total	21.48	26.31	21.36	26.29	20.20	24.83
Feed/100 lb. gain, lb.						
HM corn grain	728	663	697	615	700	616
Haylage	6	131	5	120	6	131
Suppl.	75	66	73	60	77	66
Total	809	860	775	795	783	813

The 4 lb. of alfalfa haylage have resulted in a considerable improvement (about 18%) in weight gain with all supplements. The response appears to be similar for each supplement. Haylage-fed steers consumed slightly more corn than those fed all-concentrate diets. While total feed requirements are higher with haylage, there is a lower requirement for concentrates (corn plus supplement). In all comparisons between all-concentrate and haylage diets, 100 lb. of haylage as fed reduced concentrate requirements per 100 lb. of gain by 73 pounds. This saving in concentrates along with a shorter feeding period (about 18% faster gain) for a given amount of gain would result in a rather high value for the haylage for equal cost of gains in comparison to all-concentrate diets.

Protein requirements of growing and finishing feedlot cattle decrease as a percentage of the diet with increasing weight and fatness. It would, therefore, be of interest to compare performance between supplements at periodic intervals during the experiment. Accumulative average gains with the percentage of the corn supplement at each weigh period are shown in table 3.

Table 3. Accumulative Average Gain by Weigh Periods as Affected by Protein Supplementation and Type of Diet

	Type of supplement		
	Corn	SBOM	Urea
All-concentrate diets			
28 days			
Avg. gain to date	74	95	88
% of corn		129	118
56 days			
Avg. gain to date	167	172	169
% of corn		103	101
84 days			
Avg. gain to date	239	248	226
% of corn		104	95
98 days			
Avg. gain to date	263	274	254
% of corn		104	97
Diets with 4 lb. alfalfa haylage			
28 days			
Avg. gain to date	95	106	97
% of corn		112	103
56 days			
Avg. gain to date	185	198	175
% of corn		107	94
84 days			
Avg. gain to date	277	291	249
% of corn		105	90
98 days			
Avg. gain to date	309	325	302
% of corn		105	98

There was an improvement in weight gain from protein supplementation during the first 4 weeks of the experiment. The improvement was greater for soybean meal than for urea and greater with the all-concentrate diet than with 4 lb. of alfalfa haylage. After this time there was no advantage for protein supplementation on basis of weight gain for either the all-concentrate or haylage diets. After the first month, steers fed the urea supplement gained slightly less than those fed the corn supplement except during the last 2 weeks of the experiment. This is probably a reflection of the slightly lower feed consumption by the urea group. The small advantage after 98 days in feed efficiency for steers fed the protein supplements resulted from an improvement during the first month when weight gains were higher. After this time there was no advantage of protein supplementation on basis of feed efficiency for either the all-concentrate or haylage diets.

A comparison between the all-concentrate diets and those with alfalfa haylage by weight periods is shown in table 4. In general, the response to haylage was similar during the course of the experiment with each supplement. This would appear to be an effect from the haylage other than its protein contribution since the response was similar with and without supplemental protein.

Table 4. Accumulative Average Gain by Weigh Periods as Affected by Amount of Roughage and Protein Supplementation

	All concentrate	4 lb. haylage	Percent all concentrate
	(Avg. gain to date)		
Corn			
28 days	74	95	128
56	167	185	111
84	239	277	116
98	263	309	117
SBOM			
28 days	95	106	112
56	172	198	115
84	248	291	117
98	274	325	119
Urea			
28 days	88	97	110
56	169	175	104
84	226	249	110
98	254	302	119

Summary

One hundred forty-four steers averaging about 775 lb. (filled weight basis) were fed an all-concentrate diet or one with 4 lb. of alfalfa haylage. Reconstituted high-moisture corn was the grain source. Each diet was fed with 2 lb. per head daily of a corn supplement, a 32% protein supplement with soybean meal or a 32% protein supplement with urea. Protein content of the corn grain on a moisture-free basis was about 10.4%. The experiment is in progress, but results have been summarized after 98 days.

Both sources of supplemental protein resulted in an improvement in weight gain during the first 4 weeks of the experiment. There was more improvement from soybean meal than from urea and more with all-concentrate diets than with those which contained 4 lb. of alfalfa haylage. After the initial 4 weeks and

cattle weights averaging about 850 lb., there was no advantage of protein supplementation with either diet. Those fed urea generally gained at a slightly lower rate than those fed no supplemental protein after the first 4 weeks.

Steers fed diets with 4 lb. of alfalfa haylage gained about 18% faster than those fed all-concentrate diets. The response to haylage was similar for all supplements and at various times during the experiment. Corn consumption was slightly higher with haylage. While total feed requirements per 100 lb. of gain were higher with haylage, there was a reduction in requirements for concentrates (corn plus supplement). On the basis as fed, 100 lb. of the haylage reduced concentrates required per 100 lb. of gain by 77 pounds. The effect of alfalfa haylage appeared to result from factors other than the additional protein contributed since the response was similar for diets with and without supplemental protein.

Protein content of the dry diets without alfalfa haylage (about 10.4%) is lower than recommended (11.1%, National Research Council) for cattle of the weights in this experiment.